COMMONWEALTH OF AUSTRALIA

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Warning

CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 2, 2015

FINAL EXAMINATION	**DURATION**
SPH141 – Concepts of Physics	Reading Time: **10** minutes Writing Time: **180** minutes

INSTRUCTIONS TO CANDIDATES

The examination has SIX questions. Please read all questions carefully.

EXAM CONDITIONS

This is a RESTRICTED OPEN BOOK examination

Any non-programmable calculator is permitted

One A4 sheet of handwritten double-sided notes permitted

No dictionaries are permitted

Answer on the supplied examination material/s only

ADDITIONAL AUTHORISED MATERIALS	**EXAMINATION MATERIALS TO BE SUPPLIED**
No additional printed material is permitted.	2 x 16 Page Book

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1 (17 marks)

Part 1 (7 marks)

A runner covers one lap of a circular track 40 m in diameter in 62.5 s.

a) For that lap, what were her average speed and average velocity? (*5 marks*)
b) If she covered the first half-lap in 28.7 s, what were her average speed and average velocity for that half-lap? (*2 marks*)

Part 2 (10 marks)

A physics book slides off a horizontal tabletop with a speed of 1.10 m/s. It strikes the floor in 0.35 s. Ignore air resistance. Find

a) The height of the tabletop above the floor (*3 marks*)
b) The horizontal distance from the edge of the table to the point where the book strikes the floor (*3 marks*)
c) The horizontal and vertical components of the book's velocity, and the magnitude and direction of its velocity, just before the book reaches the floor (*4 marks*).

Question 2 (14 marks)

Part 1 (7 marks)

An astronaut's pack weighs 17.5 N when she is on Earth but only 3.24 N when she is on the surface of an asteroid.

a) What is the acceleration due to gravity on this asteroid? (*5 marks*)
b) What is the mass of the pack on the asteroid? (*2 marks*)

Part 2 (7 marks)

Adult cheetahs, the fastest of the great cats, have a mass of about 70 kg and have been clocked at up to 72 mph (32 m/s).

a) How many Joules of kinetic energy does such a swift cheetah have? (*4 marks*)
b) By what factor would its kinetic energy change if its speed was doubled? (*3 marks*)

Question 3 (19 marks)

Part 1 **(13 marks)**

Two cars collide at an intersection. Car A, with a mass of 2000 kg, is going from west to east, while Car B, of mass 1500 kg, is going from north to south at 15 m/s. As a result of this collision, the two cars become enmeshed and move as one afterwards. After collision, the enmeshed cars moved at an angle of 65^{o} South of East from the point of impact.

a) How fast were the enmeshed cars moving just after the collision? (*8 marks*)
b) How fast was Car A going just before collision? (*5 marks*)

Part 2 **(6 marks)**

The piston of a hydraulic automobile lift is 0.3 m in diameter.

a) What gauge pressure, in Pascals, is required to lift a car with a mass of 1200 kg? (*5 marks*)
b) Express this pressure in atmospheres (*1 mark*)

Question 4 (18 marks)

Part 1 **(11 marks)**

One suggested treatment for a person who has suffered a stroke is to immerse the patient in an ice-water bath at $0\ ^{0}C$ to lower the body temperature, which prevents damage to the brain. In one set of tests patients were cooled until their internal temperature reached $32.0\ ^{o}C$. To treat a 70 kg patient

a) What is the minimum amount of ice (at $0\ ^{o}C$) that you need in the bath so that its temperature remains at $0\ ^{o}C$? The specific heat capacity of the human body is 3480 $J/(kg\cdot{}^{o}C)$, heat of fusion (melting) of water is 334.1 kJ/kg, and assume that normal body temperature is $37.0\ ^{o}C$ (*11 marks*)

Part 2 **(7 marks)**

A ray of light in medium A (see Figure 1) strikes the surface at 51.0^{o} with respect to the normal.

a) What is the angle of refraction of this ray with respect to the normal in medium B? (*4 marks*)
b) Will total internal reflection occur? Explain why or why not. (*3 marks*)

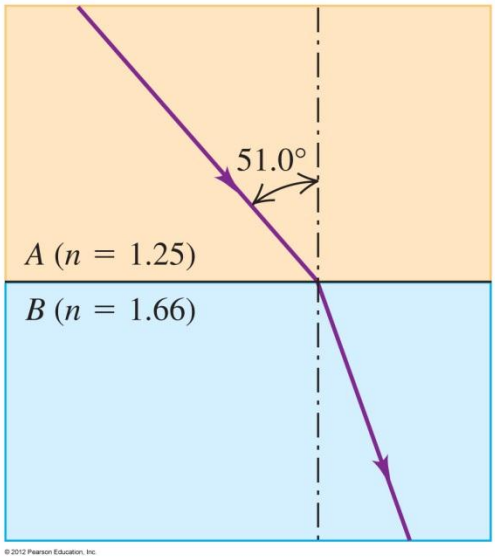

Figure 1: Question 4, Part 2.

Question 5 (18 marks)

Part 1 **(8 marks)**

Two small spheres spaced 20 cm apart have equal electrical charge. How many excess electrons must be present on each sphere if the magnitude of the force of repulsion between them is 4.57 x 10^{-21} N? A charge of a single electron is -1.60 x 10^{-19} C (*8 marks*)

Part 2 **(10 marks)**

At a given instant, a particle with a mass 5.00 x 10^{-3} kg and a charge of +3.50 x 10^{-8} C has a velocity of 2.00 x 10^{5} m/s along the +*y*-direction. It is moving in a uniform magnetic field that has magnitude 0.8 T and is in the –*x*-direction.

a) What are the magnitude and direction of the magnetic force on the particle? (*7 marks*)
b) What is the particle's resulting acceleration? (*3 marks*)

Question 6 (14 marks)

Part 1 (7 marks)

A 1.5-m-long rope is stretched between two supports with a tension that makes the speed of transverse waves 48.0 m/s. What are the wavelength and frequency of

(a) The fundamental tone? (*3 marks*)
(b) The second overtone? (*2 marks*)
(c) The fourth harmonic? (*2 marks*)

Part 2 (7 marks)

A car alarm is emitting sound waves of frequency 520 Hz. You are on a motorcycle, travelling directly away from the car.

a) How fast must you be travelling if you detect a frequency of 490 Hz? (*7 marks*)